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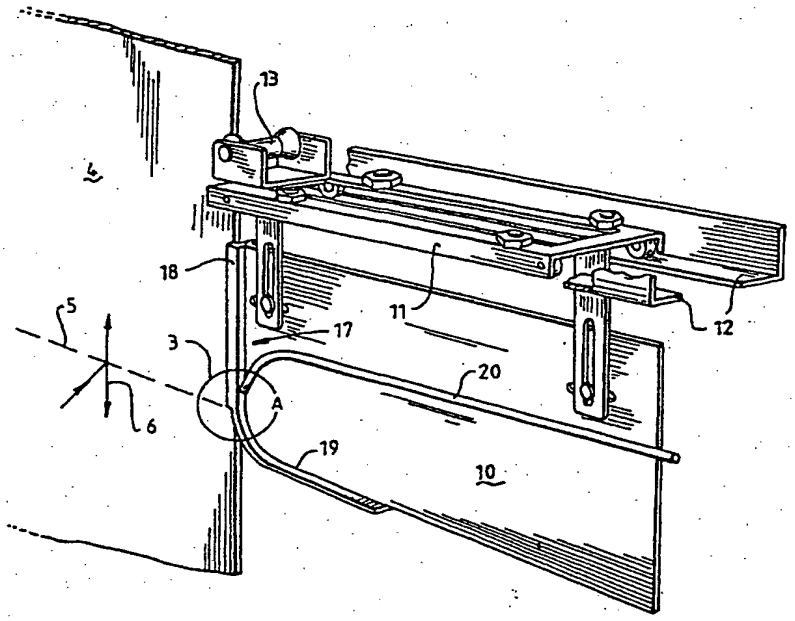
(54) Title: IMPROVEMENTS IN JET STRIPPING APPARATUS



(57) Abstract

A flow diversion device for a gas jet stripping apparatus is used to minimise edge build up when coating a moving strip. The device includes a baffle (17) having a first portion (18) extending longitudinally of the moving strip (4) and adjacent the strip, a second portion (19) extending from the first portion diverging away from the edge of the strip and a gas supply duct (20) communicating with the strip side of the baffle (17) for providing gas to at least second portion (19) of the baffle. It is preferred that the gas from the duct (20) is supplied with a velocity component in the counter direction of travel of the moving strip.

TITLE: IMPROVEMENTS IN JET STRIPPING APPARATUS

Field of the Invention

The invention relates to the continuous application of a liquid coating to a substrate strip. The invention is applicable to processes generally, in which a substrate strip is coated with a coating composition, but was devised primarily for use in the continuous galvanising of steel strip (wherein the liquid coating is molten zinc) or the continuous coating of steel strip with other liquid coatings such as molten aluminium zinc alloys or polymeric paint compositions.

Background of the Invention

It is commonplace in such processes firstly to apply an over thick layer of liquid coating material to the strip at a coating station and then strip surplus material from the over thick layer to the required thickness for the finished coat. The reduction of the over thick layer is generally carried out using a gas jet stripping apparatus.

Gas jet stripping apparatus of the prior art includes two elongated nozzles disposed one on either side of the strip's pass line, which direct sheetlike jets of gas against the respective sides of the thickly coated strip. The two nozzles extend transversely of the strip at right angles to the direction of strip travel. Each gas jet impinges normally or at a certain angle sometimes as large as 30° to the strip, and splits into two gas streams flowing over the surface of the strip. One such stream flows in the direction of strip travel and the other flows in the opposite direction. Thus, one of the streams flow counter to the oncoming over thick layer and blows material from the layer back upon itself. The net effect is to prevent all but a thin layer of coating material in close adherence to the substrate strip from travelling with the strip past the nozzles.

For any particular installation, each nozzle is at least as long as the maximum width of strip that may be processed by the installation. Thus, whenever strips of lesser width are being processed, the nozzles extend beyond the edges of the strip. It follows that, beyond the edges of the strip, the end portions of the gas jets meet in opposition, producing a turbulent flow pattern

the baffle and thus sweeps across the edge of the strip. In so doing it carries coating material from the margin across the edge and discharges it from the strip as free droplets, so reducing the marginal coating thickness.

It has been found that such prior known gas flow control baffles, at least as applied to strips travelling vertically upwardly from a coating station, become less effective at slow strip speeds. This is because at low strip speeds there is less coating material to be dragged up by the moving strip, and the gas pressure supply to the nozzle has to be reduced to ensure that a sufficiently thick final coating is achieved. It is thought that this reduces the tendency of the gas flow to follow the diverging baffle portion with consequent reduction in the discharge from the margin of the over thick coating.

Disclosure of the Invention

The object of the present invention is to alleviate the above deficiency.

Accordingly, the invention provides a gas jet stripping apparatus for reducing the thickness of the liquid coating on a moving strip including a pair of opposed gas jet stripping nozzles defining a stripping region, and a flow diversion device for positioning between said nozzles in said jet stripping region and adjacent said moving strip, said flow diversion device including a baffle having a first portion extending longitudinally of the strip adjacent the longitudinal edge of the strip, a second portion diverging away from the edge of the strip, and a gas supply duct communicating with the strip side of the baffle for providing gas to at least the second portion of the baffle.

It is thought that by supplying supplementary gas adjacent the baffle and directed over at least the strip side of the second portion of the baffle, less counter flowing gas stream at the strip edges and edge build up is greatly reduced.

In a preferred form of the invention, the gas is supplied to the strip side of the baffle in proximity to the junction of the first and second portions of the baffle having a velocity component in a direction which is counter to the direction of travel of the strip.

The prior art gas flow control device of Figure 1 is typical of those found in a steel strip galvanising or similar metal coating line. The strip 4 being coated is shown rising vertically as from a hot dip coating pot (not shown). On leaving the pot the strip is covered with an over thick layer of a molten metal or metal alloy coating. Two sheet like stripping jets of gas, for example air, steam or nitrogen, are directed respectively at the sides of the strip 4 by elongated nozzles (not shown) extending transversely of the sheet on opposite sides thereof. The jet on the side of the sheet that is visible in the Figure impinges on that side along the broken line marked 5 to define a stripping region and divides into two gas streams, as indicated by the arrows in the Figure. One stream is directed upwardly or in the direction of the moving strip and the other, referred to herein as the counter flowing gas stream and referenced 6, is directed downwardly or in the counter direction of strip movement. The counter flowing gas stream 6 is responsible for the stripping effect by blowing coating material downwardly or in the counter direction towards the dipping pot. The stripping jets directed at the hidden side of the sheet 4 are in register with the jets shown in Figure 1.

The prior art flow control device shown in Figure 1 includes a baffle 7, being a metal strap with a width dimension perpendicular to the plane of the strip 4 and having a first portion 8 extending longitudinally of the adjacent edge of the strip 4 and a second portion 9, being an extension of the first portion 8, of a curved or arcuate shape diverging from the edge of the strip 4 in the counter direction of strip movement.

The baffle 7 may be supported by a carrier plate 10 lying substantially in the plane of the strip 4 and suspended from a carriage 11 able to move along rails 12 defining a travel path for the carriage 11 that also lies in the plane of the strip 4.

The carriage is loaded towards the strip 4 by any suitable means (not shown). The operating position of the carriage is thus determined by a buffer roller 13 on the carriage 11 in contact with the edge of the strip 4. The position

believed that a proportion of the gas exiting outlet 23 follows the contour of the diverging second portion of the baffle reducing the air pressure near the strip edge 24 and entraining some of the counter flowing gas stream 6 with it. Be that as it may, it has been found that the supply of the supplementary gas at this point augments the stripping effect of the gas stream on the margin of the coating.

In one exemplary embodiment of the invention of Figures 2 and 3 the height of the baffle portion 18 may be any suitable dimension typically up to 21 mm with a wall thickness of about 0.5 mm, and the cross section of the hollow interior through which the supplementary gas stream flows is about 20 x 1 mm.

In this instance the gas pressure of the supply source may be at or above 2OOkPa above ambient pressure, with a conventional pressure regulator interposed between it and the supply tube to enable appropriate control setting of the rate of gas flow from the first baffle portion 18.

With the supply tube angled downwardly, as shown in the configuration of Figure 3 at its entry to the baffle portion 18, there is no need to plug the top open end of the baffle, but in other embodiments wherein the tube is not so shaped and is, for example, perpendicular to the baffle it may be desirable so to do.

In view of the increased thickness of the upper portion 18 of the baffle, it is desirable to chamfer its vertical edges so that the vertical corner line nearer to the strip 4 is sharp and thereby better separates the portion of the jet stream playing onto the strip 4 from any end parts playing onto the carrier plate 10.

In the embodiment shown in Figure 3, the gas is directed from gas outlet 23 initially at an angle $\alpha = 0°$ to the longitudinal direction of the strip.

As shown in the other embodiments of the invention, it is within the scope of the invention for the angle α of the gas to be within the range of +30° to -30° relative to the longitudinal direction of the first portion of the baffle. In preferred forms of the invention injection angle of the gas is within the range

made for positive injection ie. towards the strip. It would be appreciated by those skilled in the art that in all circumstances, the injection of gas is generally in the counter direction of travel of the moving strip 4 and that the gas stream has a velocity component in the counter direction of travel of the strip.

As shown in Figure 7(a), the injection outlet 55 may be a slit having a typical width of from about 0.5mm to 5mm and extend substantially the width of the baffle. Alternatively, the slit may consist of multiple outlets 56 aligned across the baffle, outlets 57 spaced along the baffle or a combination of both arrangements (see Figures 7(b) to 7(e)). The choice of arrangement is dependent on such considerations as the size of the jet stripping operation, the volume of gas being injected and the pressure of the gas supply.

There are some distinct advantages to using multiple injection outlets. By increasing the number of injection outlets, the volumetric flow of gas can be increased without increasing the velocity of the gas passing through the nozzles thereby maintaining or reducing the noise created by the gas leaving the nozzles. Additionally, the use of multiple outlets provides better gas flow direction control. Other advantages of using multiple injection outlets would be apparent to those of ordinary skill in the art.

While the number of injection outlets is dependent on the jet gas stripping operation it is essential that the gas is delivered to the strip side of the baffle with a directional component which is counter to the direction or movement of the strip. In this way the gas which enters the region between the strip and diverging curved portion of the baffle, comes under the aerodynamic influence of the diverging curved baffle portion drawing excess coating material away from the edges of the strip. In this way the aerodynamic influence of the diverging curved portion of the baffle is greatly enhanced.

In prior art gas jet stripping apparatus, it is desirable for the baffle and carrier plate to be as close as possible to the moving strip in an attempt to minimise the edge effects. However, the applicant has found that by providing a stream of gas with a directional velocity component counter to the direction

CLAIMS:

1. A jet gas stripping apparatus for reducing the thickness of the liquid coating on a moving strip including a pair of opposed gas jet stripping nozzles defining a stripping region, and a flow diversion device for positioning between said nozzles in said stripping region and adjacent said moving strip, said flow diversion device including a baffle having a first portion extending longitudinally of the strip adjacent the longitudinal edge of the strip, a second portion diverging away from the edge of the strip, and a gas supply duct communicating with the strip side of the baffle for providing gas to at least the second portion of the baffle.

2. The jet gas stripping apparatus of claim 1 wherein the gas supply duct communicates with the strip side of the baffle in proximity to the junction of the first and second portions of the baffle.

3. The jet gas stripping apparatus of claim 1 wherein the baffle is provided with at least one injection outlet, the gas supply duct communicating with said injection outlet.

4. The jet gas stripping apparatus of claim 1 wherein the gas from the injection outlet is directed counter to the direction of travel of the strip on the strip side of the baffle.

5. The jet gas stripping apparatus according to claim 4 wherein the gas from the at least one injection outlet is directed towards the strip at an angle within the range of +30° to -30° from the direction of travel of the strip.

6. The jet gas stripping apparatus according to claim 4 wherein the gas from the at least one injection outlet is directed towards the strip at an angle within the range of +20° to -20° from the direction of travel of the strip.

7. The jet gas stripping apparatus according to claim 4 wherein the gas from the at least one injection outlet is directed towards the strip at an angle within the range of +15° to -5° from the direction of travel of the strip.

8. The jet gas stripping apparatus according to claim 1 wherein the gas supply duct supplies gas to a gas plenum, the gas plenum communicating with

the range of +15° to -5° from the longitudinal edge of the strip.

18. The flow diversion device according to claim 13 wherein the gas supply duct supplies gas to a gas plenum, the gas plenum communicating with the at least one injection outlet.

19. The flow diversion device according to claim 18 wherein a plurality of injection outlets are provided, each outlet being supplied by said gas plenum.

20. The flow diversion device according to claim 13 wherein the at least one injection outlet has a shape selected from the group consisting of a round nozzle, a square opening or a rectangular opening.

21. A method of reducing the edge build up on a coated moving strip in a gas jet stripping apparatus including a flow diversion device including a baffle having a first portion extending longitudinally of the strip adjacent the longitudinal edge of the moving strip and a second portion diverging away from the edge of the strip and a gas supply duct supplying gas to the strip side of said baffle, said method including the stops of positioning said flow diversion device adjacent the moving strip and directing gas from said gas supply duct along at least the second portion of the strip side of the baffle.

FIG. 2.

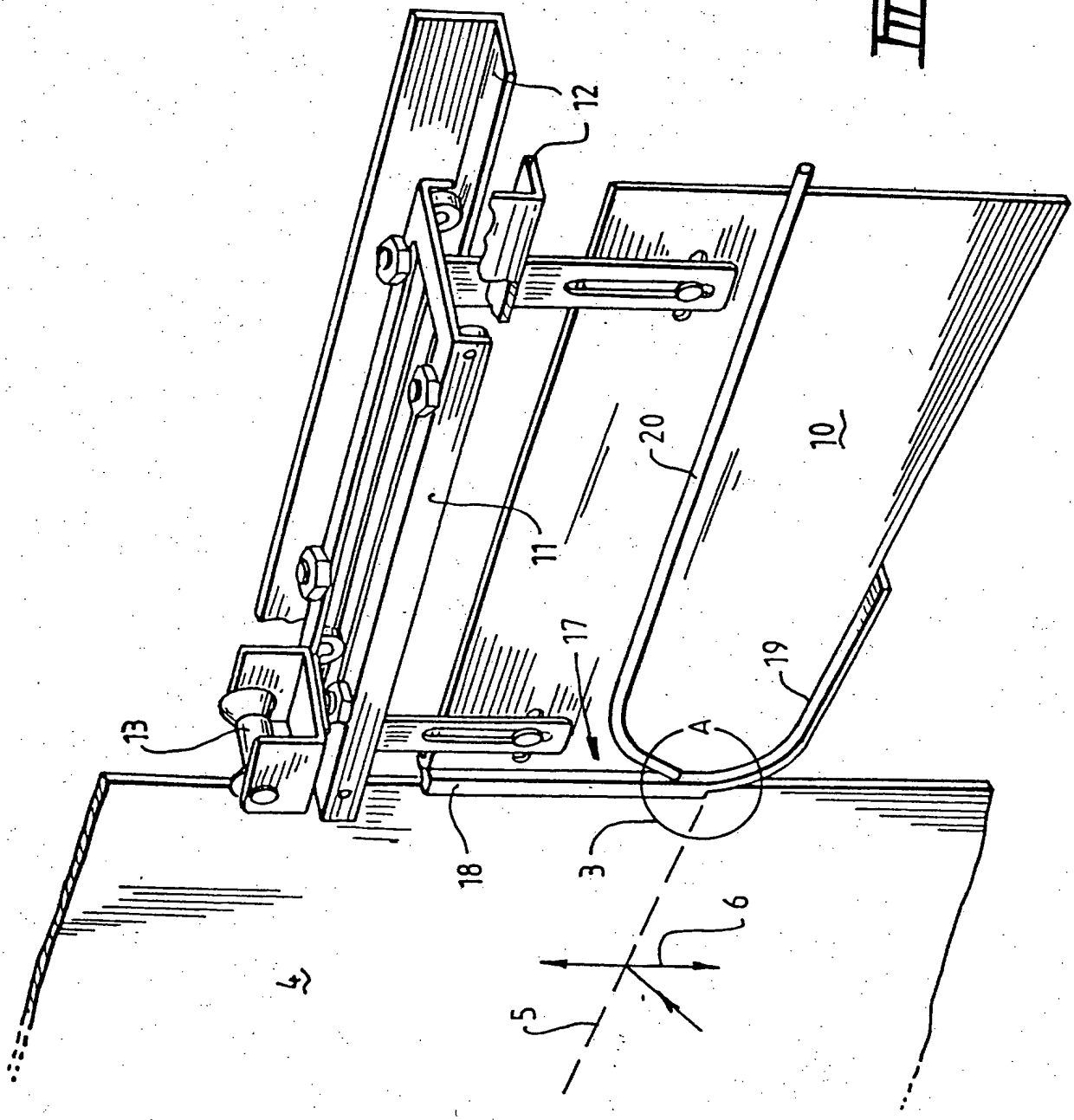
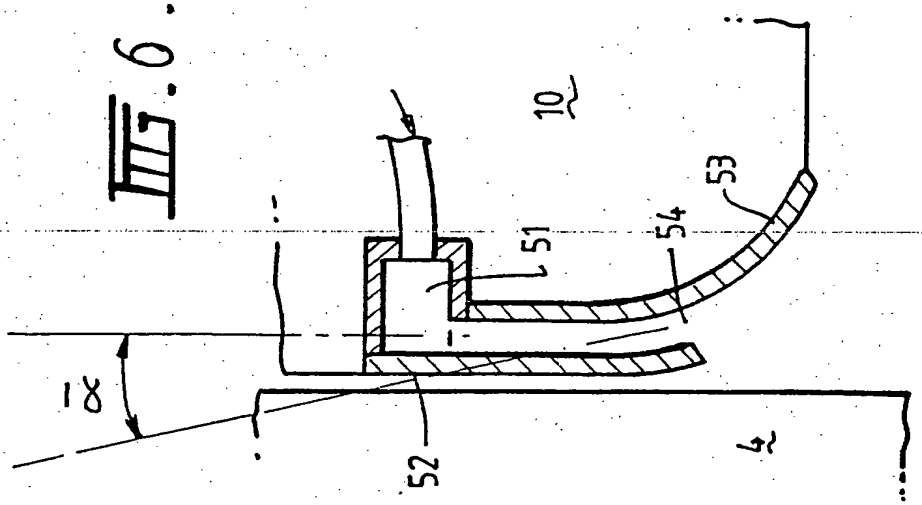


Fig. 6.



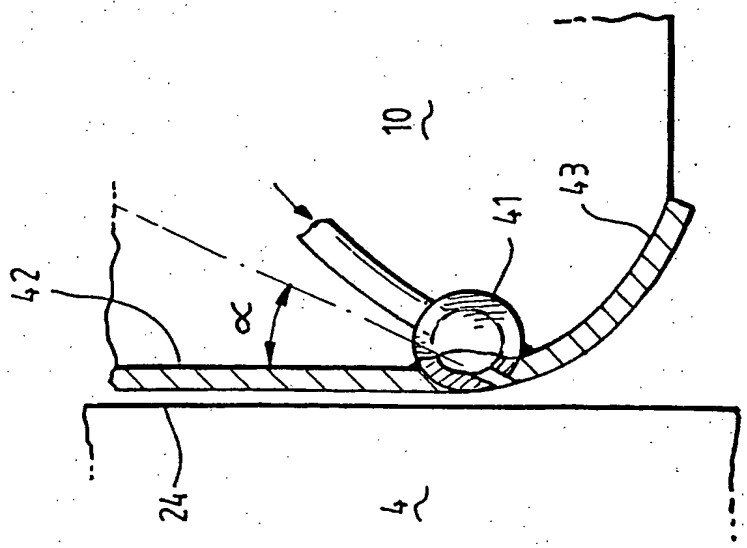


Fig. 5.

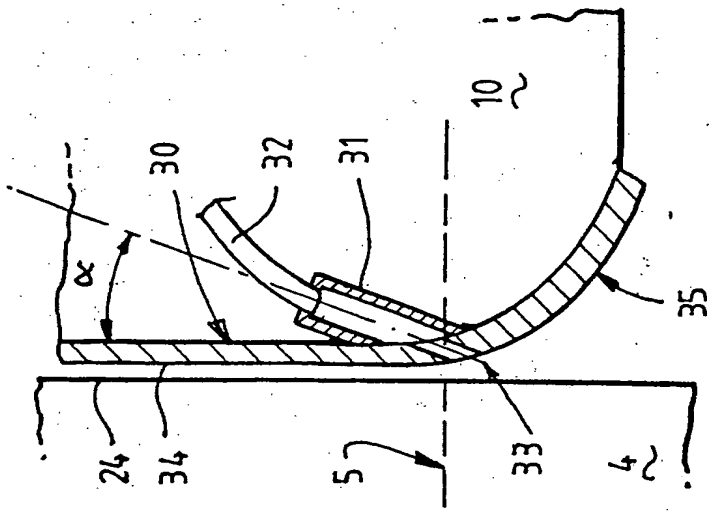


Fig. 4.

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 98/00346

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: C23C 2/20; B05C 11/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

~~IPC[6]: C23C 2/20; B05C 11/06~~

IPC[1]: C23C 1/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 55-110769 A Patent Abstracts of Japan, C-32, page 53 (SHIN NIPPON SEITETSU KK) 26 August 1980	
A	JP 62-40350 A Patent Abstracts of japan, C-436, page 50 (SUMITOMO METAL) 21 February 1987	
A	JP 63-153254 A Patent Abstracts of Japan, C-541, page 138 (SUMITOMO METAL) 25 June 1988	
A	JP 1-208441 Patent Abstracts of Japan, C-656, page 18 (KAWASAKI STEEL) 22 August 1989	

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 June 1998	-4 JUN 1998
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **DAVID LEE** Telephone No.: (02) 6283 2107

Form PCT/ISA/210 (second sheet) (July 1992) copbko

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/AU 98/00346

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
JP	55-110769	NONE					
JP	62-40350	NONE					
JP	63-153254	NONE					
JP	1-208441	NONE					
JP	2-238551	CA	1222077	EP	146894	JP	60130235
		US	4670874				
JP	06-158261	NONE					
AU	71753/87	NONE					

END OF ANNEX